

Figure 15. Projected future inundation surface map of the project area. (Note this image assumes the Matador Ranch engages in a similar project in the future and is presented to demonstrate modeling capabilities). This map assumed a 2-foot average aggradation of the entire channel without new beaver dams. Channel type will be fluvially heterogeneous and complex with significant near channel wetlands.

4.3 Risk Assessment of Design

The principle project risk is grade control structure failure under high flow events before the channel bed has uniformly aggraded to structure height. If structures fail before full aggradation behind then the channel could downcut to its preexisting bed elevation. However, in this scenario the structures in the degraded state will still have some functional influence over channel bed height as a less robust riffle. Modes of possible failure and design elements incorporated in the as-built design to address this include:

- Structure flanking – structures are keyed 4 feet into each bank. Further, flow energy at and upstream of the structure crests will be in a backwatered condition and have little erosive potential.
- Downstream structure slope degradation – this slope is armored with 3-8” screened cobble. In a large erosive event this slope will be partially stripped and material transported downstream. The result is a lower slope elevation and longer riffle. This slow degradational process is expected during the life of the structures and meets our design intent that the structures are deformable over time under the influence of fluvial processes.

Based on current performance of the similarly designed downstream structures on the J-Bar-L Ranch we consider the risk of structure failure during normal peak runoff events to be low.

4.4 Planned Riparian Restoration Efforts

4.4.1 Woody Riparian Planting

Beginning in Spring of 2016 TNC will begin implementation of a 3-year riparian planting effort in the project reach utilizing strategies that have been successful in the Centennial Valley on their other projects. This will include a combination of the following:

- Dormant willow stem pole plantings with a water-jet stinger;
- Tubling willow plantings grown from local seed sources;
- 1-2 gallon containerized willows grown from local seed sources.

The spring 2016 plantings will emphasize banks that will be largely unaffected by the pending structure placements. Succeeding year plantings will emphasize areas proximate to the structures and the newly activated floodplain wetlands. Plantings will be adaptively managed and continue until an assessment is made that the channel will have a self-supporting riparian community deemed suitable for the site colonization by beaver. This timeline is currently predicted to be 8-10 years.

4.4.2 Grazing Management

The TNC property has not been grazed by cattle for 3 years. Grazing will not continue until TNC biologists determine when limited and well-timed grazing is appropriate for valley bottom conditions. At such time grazing will be limited to areas outside of the stream corridor.

5 Project Performance Monitoring

Because the project is on TNC owned land and also utilized by fluvial arctic grayling the project will be under regular observation by project partners (Montana State University and others) and TNC staff. This will include visual and photographic documentation of channel conditions during and after runoff events. In addition to this persistent level of observation the following quantitative monitoring program will be undertaken:

1. Surface flow monitoring stations utilized by TNC in 2010-13 will be reactivated in early Spring 2016 and be recording flows in the non-winter period for a minimum of 3 years.
2. A wetland delineation of the project area will occur in the Spring of 2016 and document existing surface vegetation for a baseline that will be compared to a delineation to be completed in 2019.
3. A number (to be determined) of shallow groundwater monitoring well transects will be established beginning in early Spring 2016. These will include a combination of continuous recording wells and manually recorded wells. Combined with periodic channel water surface elevation measurements a ground water map will be compiled on an annual basis through 2019.
4. Permanent photo points will be established at each installed structure.

6 Project Cost Estimation

6.1 Construction Cost Assumptions

Project costs were estimated utilizing the downstream 2014 J-Bar-L demonstration project using the following assumptions:

- Project is approved per existing design;
- Project is executed by project designers and construction team;
- Project is executed during summer with dry equipment travel conditions.

Associated project costs are detailed in the budget spreadsheet included with our Future Fisheries Improvement Program application materials. Costs not included in this estimate include final design, permitting and monitoring costs associated with the Long Creek project.

7 Summary and Project Next Steps

This report was generated to support the raising of funds for completion of the project inclusive of a Future Fisheries grant application. When funding is secured the following project elements require completion:

1. Wetland inventory of existing project area conditions.
2. Establishment of all monitoring sites.
3. Final design, (expected to be modest), and submittal of necessary permits.
4. Construction; (target Summer 2016).

In total the project represents a long-reach scale approach to channel and floodplain/valley bottom restoration made possible by modest grade control adjustments that effectively reconnect the channel to its former active floodplain. The strategies proposed were successfully implemented on a downstream project in 2014. The guiding image for the current project is to create valley and channel conditions with a hydrology that supports a large increase in the amount of wetland and woody riparian area that when mature, is able to support a sustainable beaver population that will then require little if any further intervention. The design process relied heavily on spatial topographic data reflecting potential hydrologically connected areas including perched side channels and depression areas with inundation mapping technology. The project is considered low risk with respect to short-term performance. Unknowns about long-term success includes: 1) rate of structure adjustment and average bed aggradation and; 2) recolonization of the area by a willow community suitable for beaver inhabitation.

8 Appendix A: Design Sheets

LONG CREEK WATERSHED RESTORATION PROJECT

LOCATION: TOWNSHIP 13S, RANGE 04W, P.M.M., BEAVERHEAD COUNTY, MONTANA

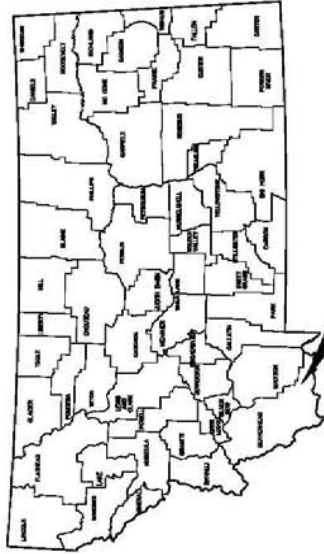
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DOWNSTREAM LATITUDE: 44.652486 LONGITUDE: -112.106084

TNC LONG CREEK RANCH

NOVEMBER 18TH, 2015

SET NO. _____



PROJECT
LOCATION

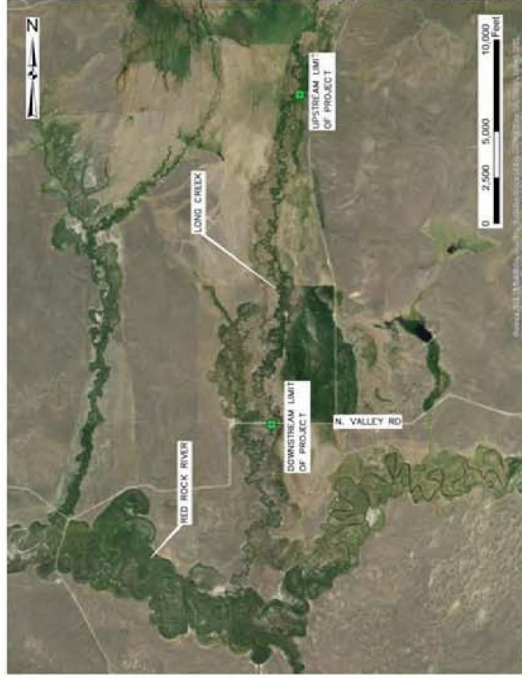


GILLILAN ASSOCIATES
MARKET-BASED CONSERVATION SOLUTIONS



Civil Engineering
Geotechnical Engineering
Land Surveying

32 DISCOVERY DRIVE
BOZEMAN, MT 59718
PHONE (406) 582-0221
FAX (406) 582-5770
www.alliedengineering.com



REACH LOCATION MAP

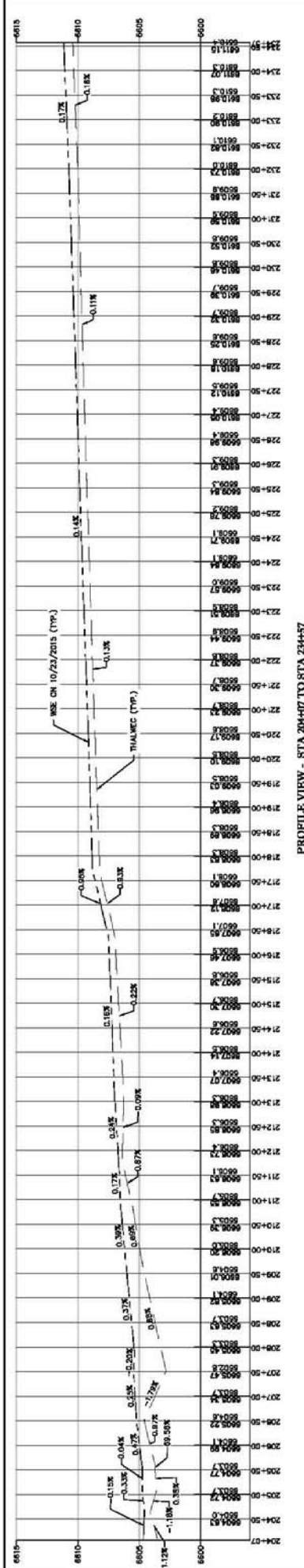
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WETLAND DOWNSIDE 500	8118	8"	
WETLAND DOWNSIDE 500	189	CY95	

SHEET INDEX

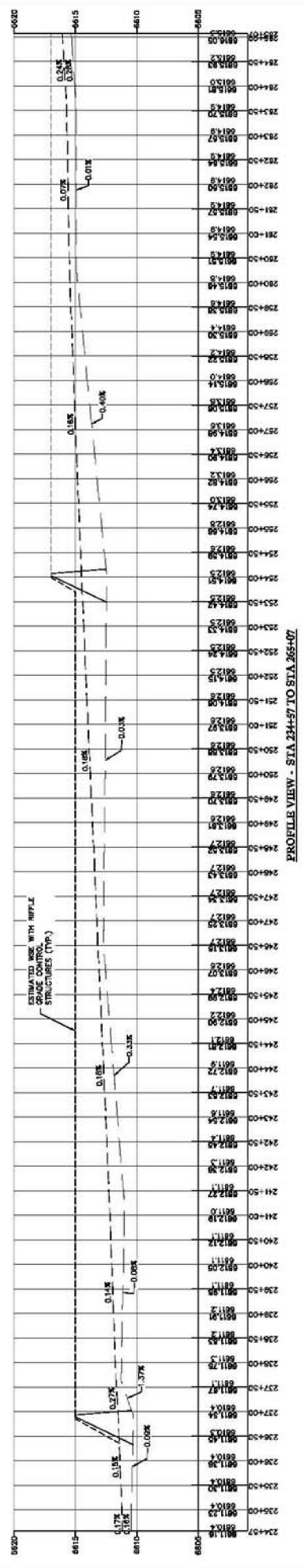
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2	DP-1	DESIGN PLAN
3	DP-2	DESIGN PLAN
4	DP-3	DESIGN PLAN
5	DP-4	PROFILE
6	DP-5	PROFILE
7	DP-6	PROFILE
8	DP-7	PROFILE
9	DP-8	CROSS-SECTIONS
10	DP-9	CROSS-SECTIONS
11	DP-10	DETAILS



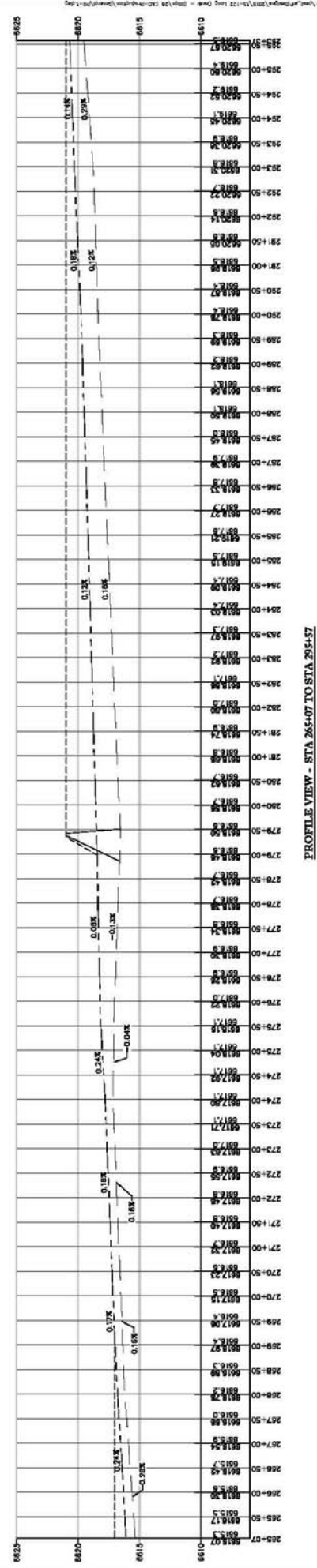
VICINITY MAP



PROFILE VIEW - STA 204+00 TO STA 234+00

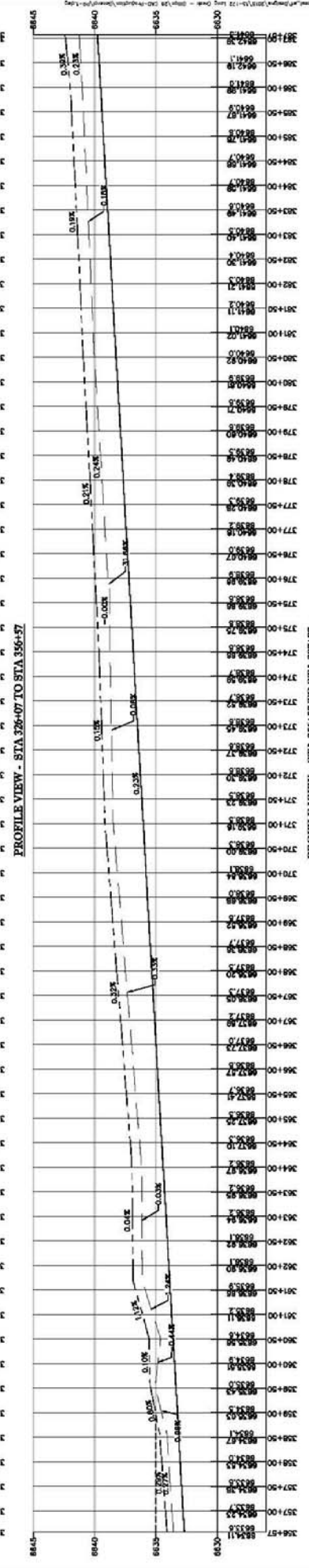
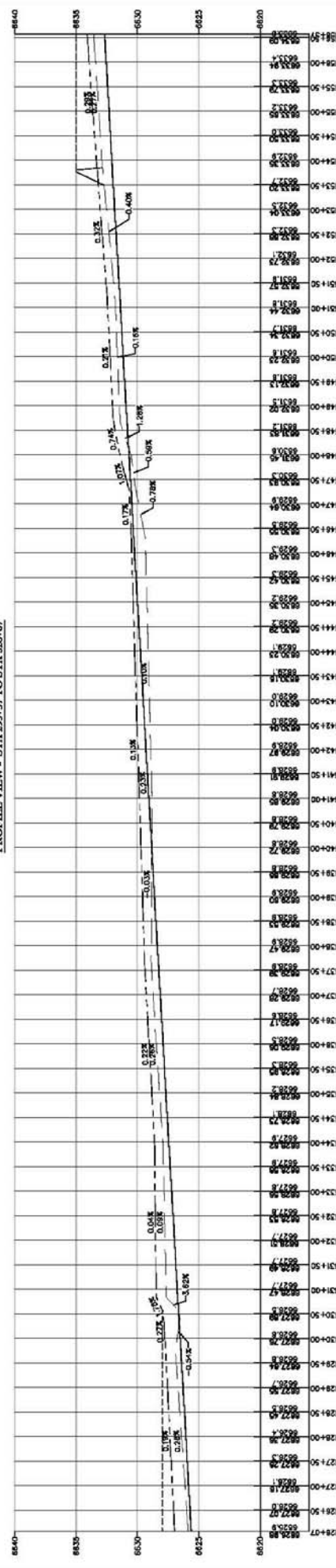
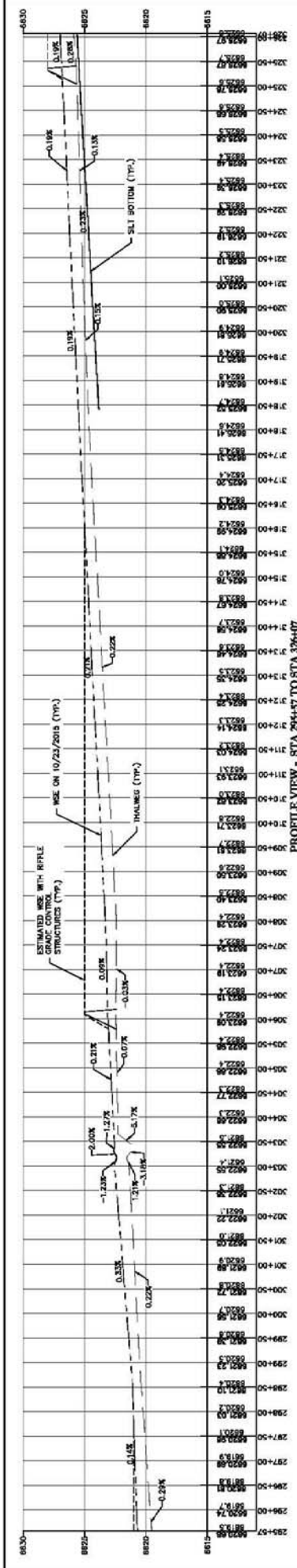


PROFILE VIEW - STA 234+00 TO STA 265+00

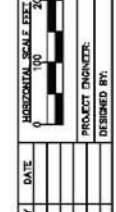
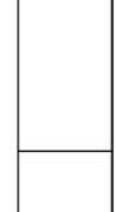
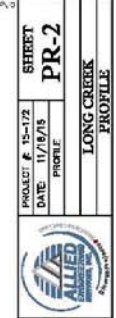


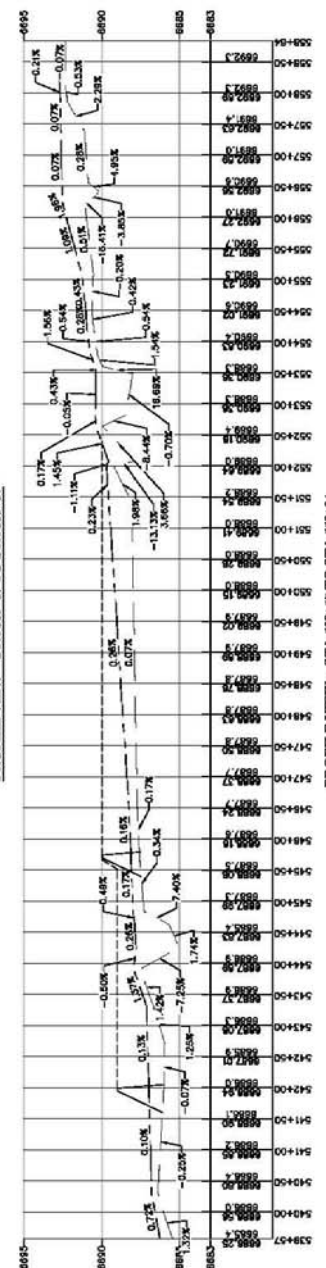
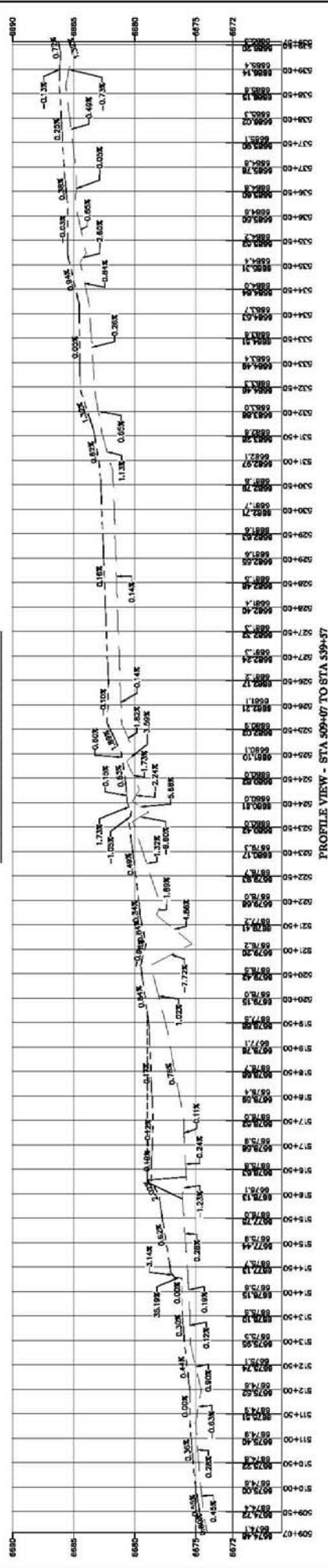
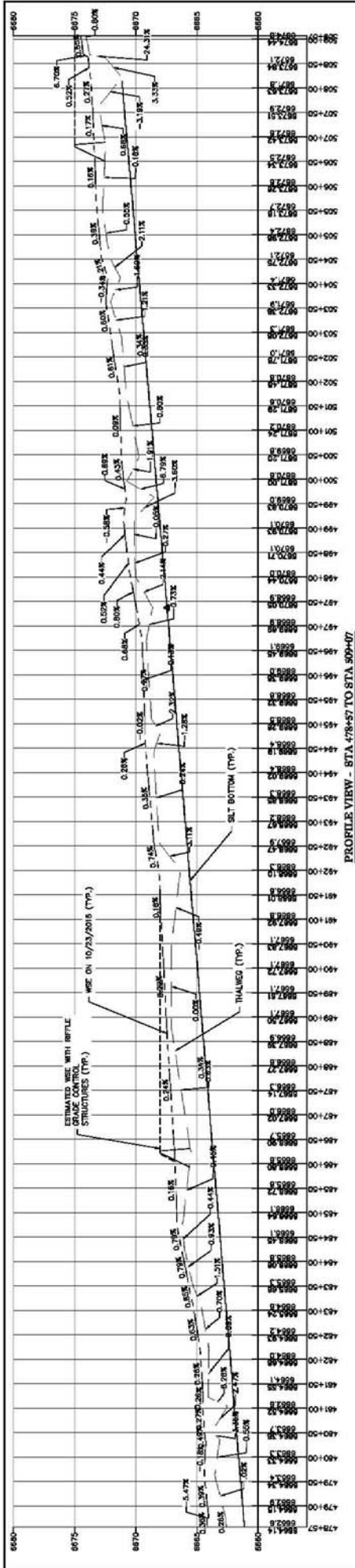
PROFILE VIEW - STA 265+00 TO STA 295+00


SHEET PR-1 DATE: 11/19/15 PROJECT:		PROJECT # 15-172 DATE: 11/19/15 PROFILE:	
LONG CREEK PROFILE BEAVERHEAD COUNTY, MT		GILLILAN ASSOCIATES MARKET-BASED CONSULTING SOLUTIONS	
NO. REVISIONS DATE DRAWN BY: JMI PROJECT ENGINEER:		VERTICAL SCALE: 1"=10' HORIZONTAL SCALE: 1"=100' PROJECT CHARTER: DESIGNED BY: JAC REVIEWED BY: PJS	

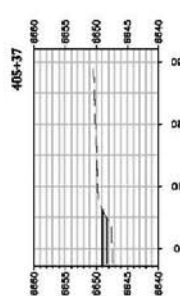
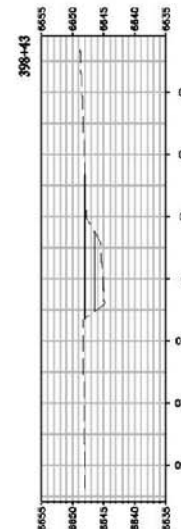
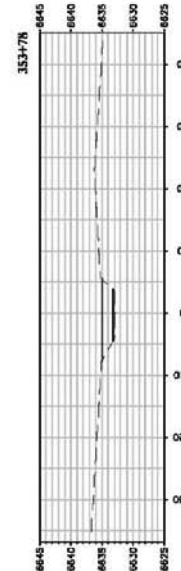
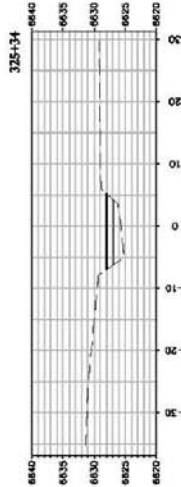
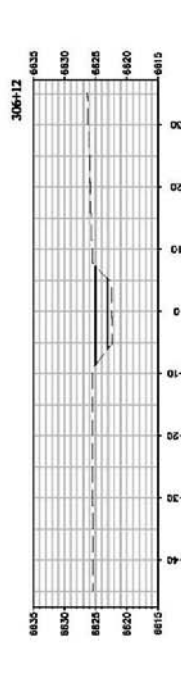
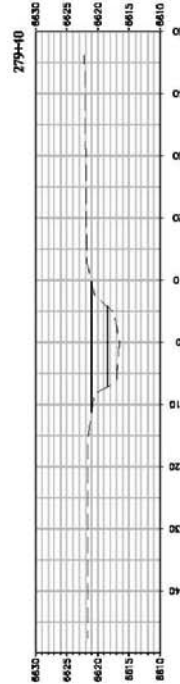
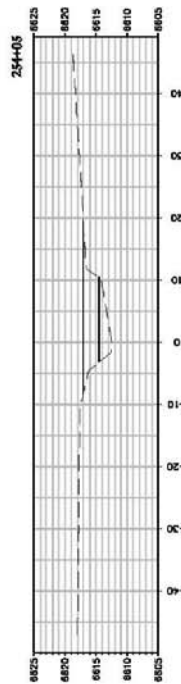
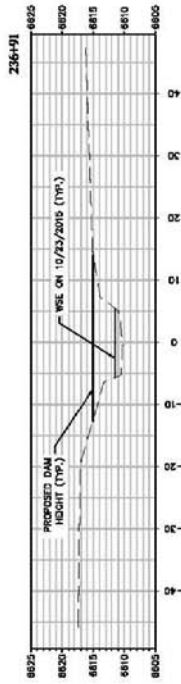


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DESIGNED BY:		DESIGNED BY:		
PROJECT ENGINEER:		PROJECT ENGINEER:		
DRAWN BY: JMI		DRAWN BY: JMI		
REVIEWED BY: PJS		REVIEWED BY: PJS		
VERTICAL SCALE: 1"=10'		VERTICAL SCALE: 1"=10'		
HORIZONTAL SCALE: 1"=100'		HORIZONTAL SCALE: 1"=100'		
PROJECT: LONG CREEK PROFILE		PROJECT: LONG CREEK PROFILE		
SHEET: PR-2		SHEET: PR-2		
DATE: 11/19/15		DATE: 11/19/15		
PROJECT # 15-172		PROJECT # 15-172		
LONG CREEK PROFILE		LONG CREEK PROFILE		





NO.	REVISIONS	DRAWN BY	DATE	 HORIZONTAL SCALE FEET	 VERTICAL SCALE FEET	 GILLILAND ASSOCIATES MARKET-BASED CONSULTATION SOLUTIONS	 ALLIED ENGINEERING 4000 Highway 100, Suite 100 Reno, NV 89502	PROJECT # 15-172 DATE: 11/18/15 PROFILE	SHEET PR-4
								LONG CREEK PROFILE	LONG CREEK PROFILE



PROJECT # 15-172
DATE 11/19/15
CROSS-SECTIONS

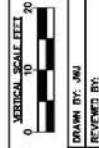


GILLILAN ASSOCIATES
MARKET-BASED CONSULTATION SOLUTIONS

LONG CREEK
CROSS-SECTIONS
BEAVERHEAD COUNTY, MT

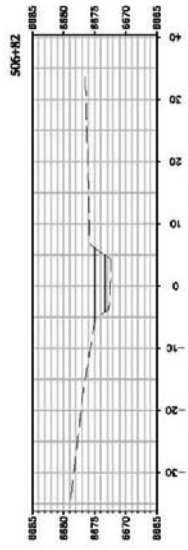
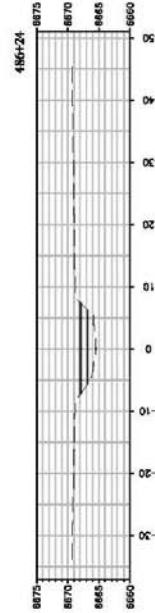
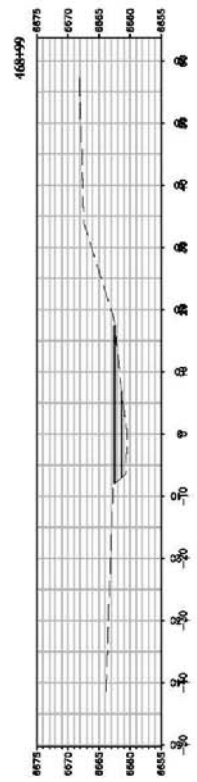
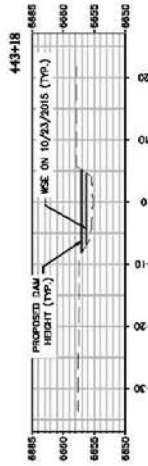
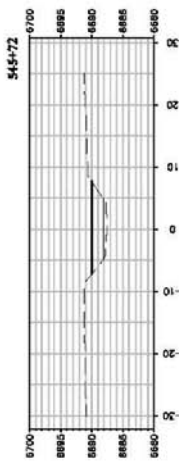
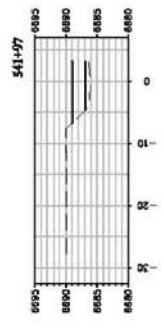
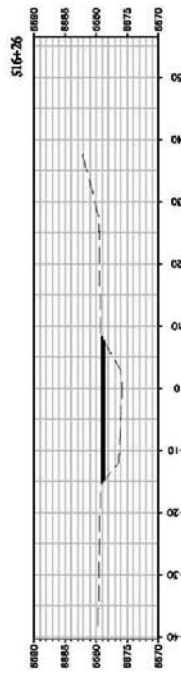
DESIGNED BY: _____
PROJECT ENGINEER: _____
DRAWN BY: JAM
REVIEWED BY: _____

NO.	REVISIONS	DRAWN BY	DATE



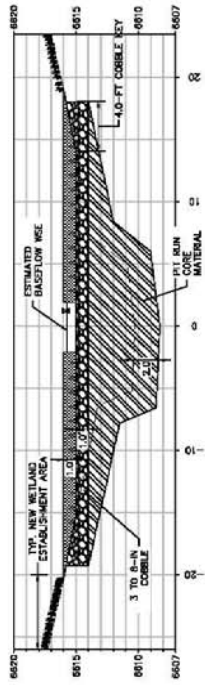
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XS-1

LONG CREEK
CROSS-SECTIONS

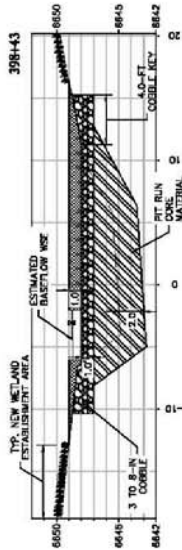


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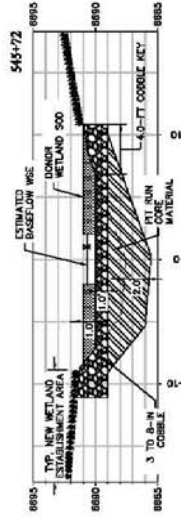
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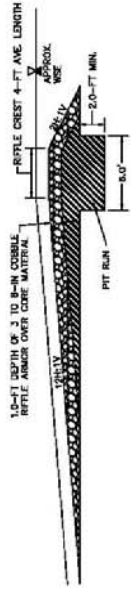
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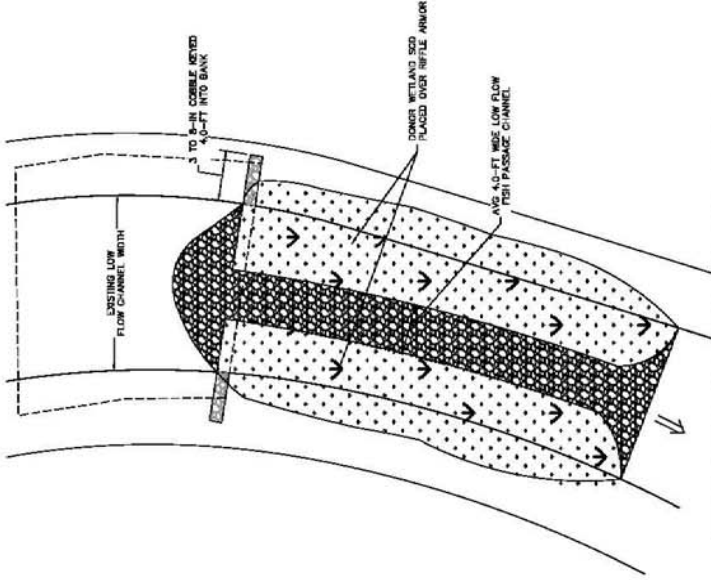


CROSS SECTION - STRUCTURE 545+72



TYPICAL RIFFLE GRADE CONTROL
STRUCTURE SECTION DETAIL

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 2. STORM EVENT FLOW ALLOW MINIMUM OF 25 YEAR
 3. STORM EVENT TO PASS WITHIN EXISTING BANKS
 4. END OF GRADE KEYWAY TO BE MINIMUM OF 12-IN ABOVE TOP OF DAM
- SOO RAMP NOTES:**
1. SOO RAMP TO BE 12-IN THICK
 2. SOO RAMP TO BE HARVESTED EXISTING FROM
 3. SOO RAMP TO BE HARVESTED EXISTING FROM
 4. SOO RAMP TO BE HARVESTED EXISTING FROM



TYPICAL RIFFLE GRADE CONTROL STRUCTURE PLAN DETAIL



EXAMPLE OF RIFFLE GRADE CONTROL STRUCTURE

NO.	REVISIONS	DRAWN BY	DATE	PROJECT #	15-172	SHEET	D-1
				DATE	11/19/15	DETAILS	
				PROJECT ENGINEER			LONG CREEK
				DESIGNED BY			DETAILS
				PROJECT ENGINEER			LONG CREEK
				DESIGNED BY			DETAILS



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MARKET-BASED CONSERVATION SOLUTIONS

LONG CREEK
DETAILS
BEAVERHEAD COUNTY, MT